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ABSIRACT

ALTHCUGH A PCSITIVE ARGUMENT CAN BE MADE FOR SUBSIDIZING COLLEGE STUDENTS, THE EXISTING SYSTEM IS CHAOTIC AND INCONSISTENT. IT IS DESIRABLE THEREFORE, TO DEVELOP A REASONABLE AND CONSISTENT PLAN FOR COLLEGE SCHOLARSHIPS. THIS PLAN WOULD EMPLOY COST-BENEFIT AND OTHER TECHNIQUES OF ECONOMIC ANALYSIS TO ATTAIN NATIONAL POLICY OBJECTIVES. IN THIS PLAN, THE SOCIAL VALUE OF A COLLEGE EDUCATICN FOR VARICUS GRCUPS OF HIGH SCHOOL GRADUATES WOULD BE MEASURED THROUGH VARIOUS MEANS BY THE SUBSIDIZING AGENCY AND THE PRIVATE VALUE BY THE FINANCIAL SACRIFICE THE POTENTIAL STUDENTS AND THEIR FAMILIES ARE WILLING TO MAKE. THROUGH ECONOMIC AND MATHEMATICAL ANALYSIS, THESE TWC FACTORS WOULD BE UTILIZED TO OBTAIN A MAXIMUM SOCIAL GAIN FROM A NATIONAL COLLEGE STUDENT SUBSIDY BUDGET.
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TOWARDS A MORE CONSISTENT, SOCIALLY RELEVANT COLLEGE SCHOLARSHIPS POLICY

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John D. Owen

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ABSTRACT

TOWARDS A MORE CONSISTENT, SOCIALLY RELEVANT
COLLEGE SCHOLARSHIPS POLICY

A positive argument can be made for subsidizing college students. Yet, the existing system is chaotic and inconsistent. It is desirable, then, to develop a reasonable, consistent plan for college scholarships. This plan would employ cost-benefit and other techniques of economic analysis to attain national policy objectives. In this scheme, estimates of the social value of college for various cohorts of high school graduates (as measured by the subsidizing agency) would be used in conjunction with measures of the private value of college (as estimated by the financial sacrifice the potential students and their families are prepared to make) to obtain a maximum social gain from a national college student subsidy budget.

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TOWARDS A MORE CONSISTENT, SOCIALLY RELEVANT COLLEGE SCHOLARSHIPS POLICY

A good argument can be made for the present practice of subsidizing the education of college students. In fact, it may well be the case that society would be better served by an expansion of this subsidy from its present level. However, college education is now supported by a patchwork quilt of subsidies, some given directly to students, others administered through the colleges. The resulting "system" is chaotic, and unlikely to yield maximum social benefit per subsidy dollar.

It would be useful, then, to develop principles for a consistent, socially relevant national policy for college student subsidy--principles whose application could either permit a more efficient deployment of the present subsidy budget or could help assure an effective use of expanded funds for college student support.

Techniques developed by economists for the more efficient use of subsidy in other areas (most especially, the techniques of cost-benefit analysis) can have a useful application for college scholarship policy. In the following pages, an attempt is made to use economic analysis to develop a systematic program for the resolution of the college scholarship problem.

Many economists, and others, believe that the subsidy of college students is justified on the grounds that, without subsidy, the private value of a youth's college education would typically be less than its social value--thus leading to a less than socially optimal level of expenditures on college education.

The social value of a youth's college education may usefully be regarded as the social benefit of his education (the present value of the net gain in his social contribution as a result of college[1] in the years subsequent to college) minus the social cost of his education (the direct and opportunity costs imposed upon society in his four years at college). Similarly, the private value may be regarded as the excess of the present value of the net private benefits from college over their private cost. Hence, the difference between the social and private value of college (in the economist's language, the positive externalities of college education) may be usefully considered to have three sources: an excess of net social benefits over net private benefits; an excess of net private costs over net social costs; and (since most of the payoffs from college take place in the years subsequent to graduation) an excess of the rates at which individuals discount future net benefits over the social rate of time preference.

It is frequently argued that the net social benefits of college exceed the net private benefits: that a college education enables an individual to improve his contribution to such social goals such as expansion of national income, efficient political decision-making, equality of educational opportunity or improvement in the nation's cultural level

to an extent which will, in many cases, be greater than the pecuniary and non-pecuniary benefits which he himself receives from his college education.[2] Moreover, the social costs of his education are sometimes less than the private costs (or, at least, less than the private costs would be in the absence of subsidy). This difference may be an important one, especially if an increase in college enrollment is regarded as an effective way to reduce unemployment among this age group.

Externalities will also result if potential students discount future benefits at a rate higher than that regarded as the social rate of time preference. This may be more likely to occur in education than in many other types of investment because of the poor market in human capital; many students with restricted financial assets and limited access to capital markets will decline to make investments in themselves which they would see to be profitable if a social rate of time preference were used. This problem is, of course, less serious for middle- and upper-middle-class than for lower class youths.

The degree to which a college education will create externalities is also expected to vary among individuals and groups in the population of high school graduates. Not only will the way in which future private benefits are discounted differ among individuals (due, in part, to variations in economic circumstances), but both private and social net benefits and costs will also be different for different groups. For example, the private value of college education for non-whites is generally lower than that for whites, even when a common rate of discount is employed, partly becuase of racial discrimination in high-prestige occu-

pations.[3] Yet a strong argument could be made on political and economic grounds that the social value of college education for non-whites is at least as high as for whites. Not only may the social benefits exceed the private benefits to a greater extent for blacks, but given the differences in youth unemployment rates between the two groups, the social costs of training blacks may fall short of the private costs by a wider margin than for whites.

In the same way, the private financial value of college tends to be higher for middle-class than for working-class youths[4] even when the same rate of time discount is used, yet it is not obvious that the social value of education for the former is proportionately higher. Family contacts in the business or professional worlds often raise the private value (but not necessarily the social return) for middle-class youths, while trade-union contacts or similar blue-collar opportunities may depress the private financial return (but, again, not necessarily the social return) to college for working-class youths. Moreover, class differences in the private value of college are further exaggerated if the greater wealth of a middle-class family leads it to put a higher value on the consumption, or non-pecuniary, returns to college for its children, yet this attitude probably would not lead to a difference in the social value placed on college by the two groups of students.

Important variations in the external gains from college education may also be associated with the geographic location, aptitudes, sex, or other characteristics of a prospective student. In fact, for some

groups (for example, those with high incomes and with a strong demand for education), its private value may actually exceed its social value.

The positive externalities believed to be generated by the college education of some high school graduates are often used to argue for a system of student assistance which would increase investment in college in a way which would help to equate the social and the subsidized, private value of college education for such students. There is, at present, an extensive system of support for college students: a potpourri of state colleges and well-endowed private institutions, each providing services well below cost; of student loan programs of various types; and of private and public college scholarships. This "system" has been widely criticized as anarchic and inefficient. It would be difficult to find an economist who would describe the present college student subsidy system as an optimal way of using the limited finds available to meet the problem of underinvestment in college education by some groups in the national population of high school graduates.[5]

College student subsidies can be rationalized and made consistent in various ways. The most simple reform (and probably the most likely to be adopted) would be to expand the state college and university system, so that four-year colleges, like the present high school system, would provide services at zero tuition to all graduates of the lower educational level. An intermediate system, with subsidized tuition and admission limited to those with good academic records, could be a halfway house on the road to a universal "free" college system.

However, the subsidized tuition approach, while perhaps the most acceptable politically, has little appeal to economists. Provision of college at zero tuition almost inevitably leads to a wasteful allocation of resources: a flat tuition reduction biases the market signals confronting all high school graduates in favor of college in an arbitrary way. Moreover, resources are then redistributed, often in a regressive fashion. Wealthy students are given subsidies equal to those offered to the poor. Since these students will probably attend college whether or not a subsidy is provided, equal subsidies then afford them a "student surplus" or bonus. On the other hand, many poor but capable students are unable to forego earnings, and so enter the labor force, thus losing any chance of college subsidy. This bias in favor of the middle class contributes to the allocative distortion.[6]

Finally, the low-tuition principle does not explicitly take into account the question of educational quality, defined here as resources per student. In practice, quality variations do take place within the low-tuition college system, but again in a somewhat arbitrary way.[7]

An extension of the low-tuition principle is distasteful to many economists as a general solution to the problem of student subsidy, but a large-scale expansion of student-loan programs has more appeal. Student loans at subsidized interest rates represent an endeavor to substitute a social rate of time preference for the generally higher individual rates used (especially by the poorer youths) to evaluate

college opportunities, and thus they affect directly one of the three sources of positive externalities from college education.

Student-loan schemes of the conventional type have been criticized on the grounds that students from lower-class backgrounds (whom the programs are supposed to be designed to help) are unwilling to take the risk involved in borrowing on a scale large enough to finance both full resource costs and full opportunity costs. However, a number of imaginative programs have been suggested to meet this objection; income-sharing and forgiveness clauses could shift much of the financial risk from the student-borrower.[8]

But while loan and share proposals help to fill an important gap created by the divergence of individual and social rates of time preference, they are not a panacea for the student subsidy problem. Insofar as externalities arise from a divergence of social and private benefits and costs, rather than from high individual rates of time preference (or insofar as the various ingenious loan-share schemes fall short of the mark in solving the time preference problem), alternative, or at least supplementary, strategies are required. Moreover, if a flat reduction in interest rates is used in an attempt to correct the externalities created by a divergence of social and private costs and benefits, unfortunate allocative and redistributive effects will be produced. For example, if the social benefits of college exceed the private benefits for poor but not for wealthy students, a subsidized reduction in rates, like the zero tuition scheme, might create a surplus

or bonus for the latter, while not fully eliminating the allocative imbalance caused by the underinvestment of the former.

While repayment schemes are attractive, optimality requires that a loan or share arrangement be a part of, rather than a substitute for, a larger program which takes into account the external economies associated with the college education of different groups in the population of high school graduates. An explicit calculation of the benefits and costs of the enrollment of students from the various socioeconomic levels is in fact made today by college administrators, especially admissions and financial aid officers, in admitting new students and in offering them scholarships, subsidized loans, or other aid. The expansion of this system to all college student subsidies is a third possible approach to student aid.

An interesting proposal which utilizes some principles of college scholarship aid as a basis for a national college student support program was made by Moor:

> How is the allocation of funds to be made among those who meet the criteria both of need and of ability? If we adhere strictly to the economic justification for Federal aid, then the problem can be solved by starting with the student of greatest intellectual potential, giving him the minimum number of dollars that will be just sufficient--when added to his own financial resources--to pay for his education, continuing the procedure with the second most able student, and so on until the Federal allocation to education has been exhausted. This satisfies the requirement for getting the greatest potential return from the Federal educational investment, in the same way that a businessman selects new capital equipment on the basis of greatest potential returns, while trying to pay the lowest price for each piece of equipment.[9]

Moor's decision rule is an abstraction of some of the better principles and practices of college scholarship programs.[10] College financial aid and admissions officers do in fact rank students largely in terms of their ability (a practice which will be criticized below). Moreover, the very important (and, it will be argued, useful) principle of calculating the minimum scholarship required by a student, and refusing to offer him more than that amount, is followed by most of the better colleges in the United States. This practice is made feasible by a cartel-like agreement among the seven hundred members of the College Scholarship Service, in which a common means test is used to determine each student's financial needs and hence the size of his scholarship. The colleges thus avoid the waste of funds which would result from free competition among them for the most able students. However, college practice is superior to, or at least more sophisticated than, the Moor proposal in that the administrator (typically the admissions or financial aid officer) generally realizes that he must regard the scholarship requirements of a prospective student as a cost or price, and must weigh this price against the expected benefit to the school from his attendance.[11] The administrator is usually given a fixed sum for scholarship subsidy and told to come up with a high-quality freshman class. With funds limited, he tends to select students who offer the most ability per dollar. Naturally, ceteris paribus, students who require only partial scholarships are preferred to those who need full support. As a result, some very able students are rejected by the best American colleges in favor of others less able but not completely penniless.[12] At the same time, the present ability mix at these colleges is higher than it would be if scholarship

funds were expended as Moor suggests. If subsidies were simply given to the best applicants, with the proviso that the most able but penniless youths would always be ranked higher than slightly less able applicants with minimal subsidy requirements, funds would be quickly used up on a relatively few students, and most of the college class would be composed of more mediocre, unsubsidized students.

Moor's rule is also weak in that it neglects altogether decisions on the intensive, or quality, margin: should subsidy funds be employed to offer a maximum number of students a rather inexpensive but low-quality education; should they be concentrated on a few students, so that the ratio of resources per student is increased; or should they be used to offer some students high-quality and other students low-quality education?[13]

This decision is made today both by the college administrator, who must decide whether the path to academic excellence for his institution lies through expanding enrollment or through upgrading his staff and facilities, and by outsiders (private benefactors, state legislatures, and the like), who choose among colleges of varying quality when allocating their subsidies.

The quality of college to which a poor youth can aspire is an important issue in scholarship policy today and is likely to become even more important as the number of bright high school graduates who are unable to afford <u>some</u> form of higher education becomes a minority. Moreover, the issue has already aroused considerable controversy within

the community of administrators.[14] (An example would be the debate over whether National Merit Scholarships should continue to give a full tuition allowance--a practice which encourages the recipients to choose the best colleges--or a fixed tuition allowance, which would be expected to favor the less expensive but lower quality institutions.) It is obvious that if college student subsidy programs are to be reformed in a consistent manner, we must decide not only whether a student should be given an allowance for tuition, but also how large this allowance ought to be, and this quality-quantity decision must be incorporated into the new set of rules.

If the best principles of current college student subsidy practice are to be extracted and made the basis of a more consistent plan, a somewhat more complicated model than the Moor criterion is called for. Before this model is developed, however, a key element in both the Moor criterion and in most college practice--the dominant, or even exclusive, role given to academic ability in selecting candidates for subsidy--must be challenged. This is equivalent to using the academic ability of a youth as an index of the social value of his education.

There may be a positive correlation between the intellectual ability of a youth and the social value of his college education, but there are several reasons for believing that an exact relationship between the two is unlikely. First, as was noted above, race, class, sex, geographical location, and other factors may each be important in determining his social contribution. Empirical work has been done

on the subject of the relationship between academic ability and success in business or the professions.[15] The results suggest that while academic ability may make a positive contribution, there are other, equally important, determinants of success. Moreover, an attempt to measure empirically the relationship between academic ability and a talent of at least some social value, creativity, indicates that there is at best a rather weak positive correlation between these characteristics.[16]

Second, while the increase in social benefits a youth's college education is positively related to his contribution with this education, it may be negatively related to his contribution in its absence. As one moves up the spectrum of intellectual ability, one may find cases where the greater social contribution that a more able youth could make with a college education was more than matched by his greater social potential without it. For example, one youth might be slightly more intelligent than another, but be blessed with far more manual dexterity. Here the more able youth's comparative advantage might lie in manual work, and the net social benefits of his college education[17] for him would be less than those of his less bright fellow. Moreover, if high ability takes a long time to make itself felt (as in many occupations), the use of a positive rate of time preference will reduce its relative importance. Finally, the social cost of training the more able is typically greater because the opportunity cost of their time is higher and because more expensive resources are usually employed, and employed more lavishly. For these several reasons, one would expect

the academic ability of a youth to be at best only roughly correlated with the social value of his education.

In summary, then, positive externalities can be generated by college education which may justify its subsidy. These externalities will vary among cohorts in the high school graduate population, and in fact, are likely to be negative for some groups. Hence, a policy which explicitly considers the social and private value of college education of different cohorts would be preferable to across-the-board subsidies in the form of low tuition or of low interest rates on student loans.

It was mentioned above that the colleges have formed a cartel to set minimum subsidy levels for various economic groups in the population; individual colleges can regard the minimum subsidy level for each economic cohort as the "cost" of a student from thatgroup, and then weigh these prices in a rational manner against the benefits that the college might expect to derive from youths of differing degrees of academic promise from each cohort. It will be seen that this integration of benefits and subsidy costs can have a useful analogue in a national policy.

However, if the administration of college student subsidies is to be put on a consistent, national coordinated basis, the typical administrator's goal of obtaining students with the highest academic ability must be supplemented by a broader consideration of the social value of college education for different groups, and hence of the externalities yielded by their education. Moreover, the allocation of funds to students on a national basis will affect the ratio of educational resources

per student (and the variation among students in that ratio) in a more dramatic way than is possible for the individual college (or indeed, the College Scholarship Service) today, and will hence require a more explicit analysis.

In the following sections, an attempt is made to set forth the outlines of a consistent college student subsidy policy on these principles and to consider the changes in the allocation of educational resources it might produce.

A Model for a Consistent Student Subsidy Plan

In this model all subsidies will be distributed in accordance with a national scholarships policy. Funds are allocated to students who then, within limits set by the subsidizing agency, select their colleges. Colleges are induced to provide their services at cost.[18]

This plan is, then, to be oriented to the subsidy requirements of students. But colleges also have their interests,[19] and an argument could be made for diverting some subsidy funds to serve these ends. It would be possible to use a student-oriented subsidy program to advance certain special college interests (although the program could never be an optimal tool for their purposes). If a large portion of college subsidy funds come from New York or California, students from those states might be favored: the marginal social benefit of the college education of a New Yorker could always be considered greater than that of, say, a Texan. But a student-oriented subsidy plan could not be warped to serve every interest of the colleges. For example, it

could not be used to ensure that New Yorkers study in colleges located in their state. Moreover, it would in no way assist the school which is inefficient in the sense that it is unable to attract students in a competitive market. If such a goal is regarded as worthy of subsidy, then a separate college subsidy plan should be devised which would permit favored schools to attract students by offering their services at less than cost.

The constraints under which policymakers must operate will have important effects on the allocation of subsidy, and hence those underlying this model will be specified. These constraints are selected as typical of those under which a national scholarships policy might operate in the United States.

1. A major constraint is that the administering agency has to obtain the maximum social benefit it can with an inadequate subsidy fund or budget. (The special case where the subsidy is sufficient and does not act as a constraint will also be examined.)

2. The imposition of a budget constraint suggests another limitation: the agency may not act as a "benevolent monopsonist."[20] It may not adjust for the effects of a change in the distribution of funds among students or among educational resources (or between students and resources) upon the wage or price structure.[21] For the purposes of policymaking here, the cost of subsidizing a particular student will be the amount paid to him and to the college that trains him. The effects on the supply price of resources and on the opportunity costs of the student will not be considered.

This limitation has great empirical significance, since the subsidizing agency will often find itself confronting very different elasticities of supply for each resource that it employs. For example, in the absence of this limitation, the agency might decide to invest less in the training of the most able students if the elasticity of supply of those with the requisite intelligence to teach this group was much lower than the supply elasticity of other teachers.[22] Some form of monopsonistic behavior on the part of the agency might well serve a desirable function in terms of social welfare; after all, it would help to increase a level of investment in college education that is, presumably, sub-optimal. However, in the present model the agency is forced to act according to competitive rules.

3. Overinvestment in college education, whether by wealthy students or by those with a strong preference for education, is not to be discouraged. The agency may not charge the "over-investors" more than the actual cost of their college education.[23]

4. The student receives a check for tuition and a cash stipend. He may then attend the college of his choice.[24] However, he may not use the tuition check for living expenses. This constraint is imposed to permit competition among colleges, and to ensure that the poor student will not elect to underinvest in his college education (using a portion of his tuition subsidy to support his family).

5. The income or consumption of a student are not factors in the agency's decision. The agency will never increase a cash stipend

for consumption purposes above the minimum amount necessary to induce the student to attend a college of given quality. A corollary of this rule is that the agency may not attempt to redistribute income in favor of poor but deserving students.[25] In fact, what is suggested here would not change the present value of income streams,[26] when discounted at individual rates of time preference. The ability of the subsidizing agency, in principle at least, to offer each student a different subsidy arrangement permits granting minimal subsidies such that the subsidized student is no better of, in his own estimation (or only marginally better off), if he accepts the grant. However, if the future stream of private benefits is discounted at a common rate of time preference, say the social rate, then income will of course be redistributed. This redistribution will be minimized insofar as loan and share programs can be used to substitute social for individual rates of time preference.

6. When the subsidizing agency decides that a student is worth a subsidy of X dollars, even if his financial situation indicates that he requires somewhat more money, he is still offered the scholarship of X dollars. In this limited sense, no student is rejected for subsidy outright on the basis of his poverty. He may also vary the quality of school he attends and the tuition that he pays without invalidating his subsidy. However, this subsidy will then be changed according to a schedule chosen by the agency. This constraint is discussed more fully in the appendix I, "Problems of Preference Measurement." It is shown there that these flexible policies are actually consistent with maximizing behavior by the subsidizing agency.

7. A student may refuse subsidy altogether and attend a college of whatever quality he chooses. He is then charged no more than the actual cost of his education. This constraint prevents the agency from offering the "underinvestor" an all-or-nothing bargain, whereby he must choose between a college of the agency's choice and no college at all.

8. Students decide upon a course of study after their subsidy has been agreed upon. The agency can guess at a student's probably course of study on the basis of objective evidence, but it is not able to direct his work through manipulation of subsidy funds. This constraint might be modified in practice: a given individual might be more heavily subsidized than otherwise if he agreed to a course of study which would increase his contribution to society after graduating without increasing his earnings proportionately (the study of political theory--which might make him a better citizen--would be a good example).[27]

A repayment scheme is not introduced explicitly into the analysis, in order to simplify the discussion. However, if, as one would expect, many students have a higher rate of time preference than the social rate, it probably would be efficient to require some repayment. In this way, the subsidizing agency could, in the long run, obtain the maximum return from a given level of subsidy.[28]

The subsidizing agency, then, subject to these constraints, will attempt to use its funds so as to obtain the maximum net social value from college education. It assumed here that the agency is willing to

evaluate the social benefits and costs of the college education of different groups of potential students,[29] that it can measure their preferences, at least to the extent of predicting the amount of subsidy necessary to induce high school graduates from a given cohort to attend colleges of a given quality level (some approximate methods that might be used when this condition is not fulfilled are discussed in Appendix I, "Problems of Preference Measurement"); and that it does, in fact, use that distribution of subsidies which maximizes its objective function (some problems of finding the correct distribution are discussed in Appendix II, "The Problem of Interdependence").

With these assumptions, it is possible to describe the optimal allocation of subsidy (the debt here to the techniques of cost-benefit analysis will be obvious).[30] An optimal allocation will require that correct decisions be made in three areas: who to admit into college from the group that would not attend in the absence of subsidy (and who to reject); how much to spend on the education of those admitted; and how much subsidy to give students who would attend less-than-optimal quality colleges in its absence. On each of these margins, an optimal policy will require that an additional dollar spent for one purpose must make the same contribution to the agency's objective function as a dollar spent for any other purpose--otherwise, an improvement could be obtained by reallocating subsidy to students whose marginal contribution is higher.

If the social value of the ith student's education is designated V_i, and the subsidy required to secure his college attendance is S_i,

then the value of a dollar expended to subsidize him is

$$(1) \quad R_1 = \frac{V_1}{S_i} \quad [31]$$

Similarly, the value of an additional dollar of subsidy spent to improve the quality of a student's education will be equal to

$$(2) \quad \frac{dV_i}{dS_i} = \frac{dV_i/dk_i}{dS_i/dk_i}$$

where k_i is the social cost of the direct costs (in contrast with the opportunity costs) of his training.

Let the contribution of a marginal dollar of subsidy to the agency's objective function when the agency is maximizing be designated λ. Then it follows that resources will be increased for each subsidized student to the point where

$$(3) \quad \frac{dV_i}{dS_i} = \lambda .$$

(This will hold both for students who would attend a college of less than optimal quality.) Similarly, the social value per subsidy dollar for the marginal student admitted into the program will also equal

$$(4) \quad Rm = \frac{Vm}{Sm} = \lambda .$$

(Thus, those students for whom $\frac{V_i}{S_i} \geq \lambda$ at some quality level will be admitted; those for whom $\frac{V_i}{S_i} < \lambda$ at all quality levels will be rejected.

A further specification of this decision rule can be made by utilizing the assumption (see constraint 5) that the subsidy for each student will be set at the minimum level necessary to secure his attendance at a college of a given quality level (i.e., to ensure that he will pay

tuition of a given amount). We can reasonably assume that in order to induce him to attend the college designated, the sum of this subsidy and the discounted value of the private net benefits of his college education[32] must be at least as great as its private costs.[33] In other words, if $\hat{V}_i$ is the private value, the difference between the discounted value of the net private benefits and private costs to the ith individual of an education of a particular quality level,

$$(5) \quad S_i + \hat{V}_i \geq 0$$

would be a necessary condition to secure his attendance. The subsidy minimization rule would then dictate that the inequality be replaced with the equality

$$(6) \quad S_i = -\hat{V}_i$$ [34]

Since this rule would apply for any quality level considered for the ith student, it follows that

$$(7) \quad \frac{dS_i}{dk_i} = \frac{-d\hat{V}_i}{dk_i}$$ [35]

i.e., the increased deficit in the private value of college much be matched by an equal increase in the subsidy.

Moreover, it follows from the equation of $-\hat{V}_i$ with S_i and (3) and (4) that for the marginal dollar expended on a subsidized student,

$$(8) \quad \frac{dV_i}{dS_i} = \frac{-dV_i}{d\hat{V}_i} = \frac{\frac{dV_i}{dK_i}}{\frac{-d\hat{V}_i}{dK_i}} = \lambda$$

and for the marginal student admitted into the program,

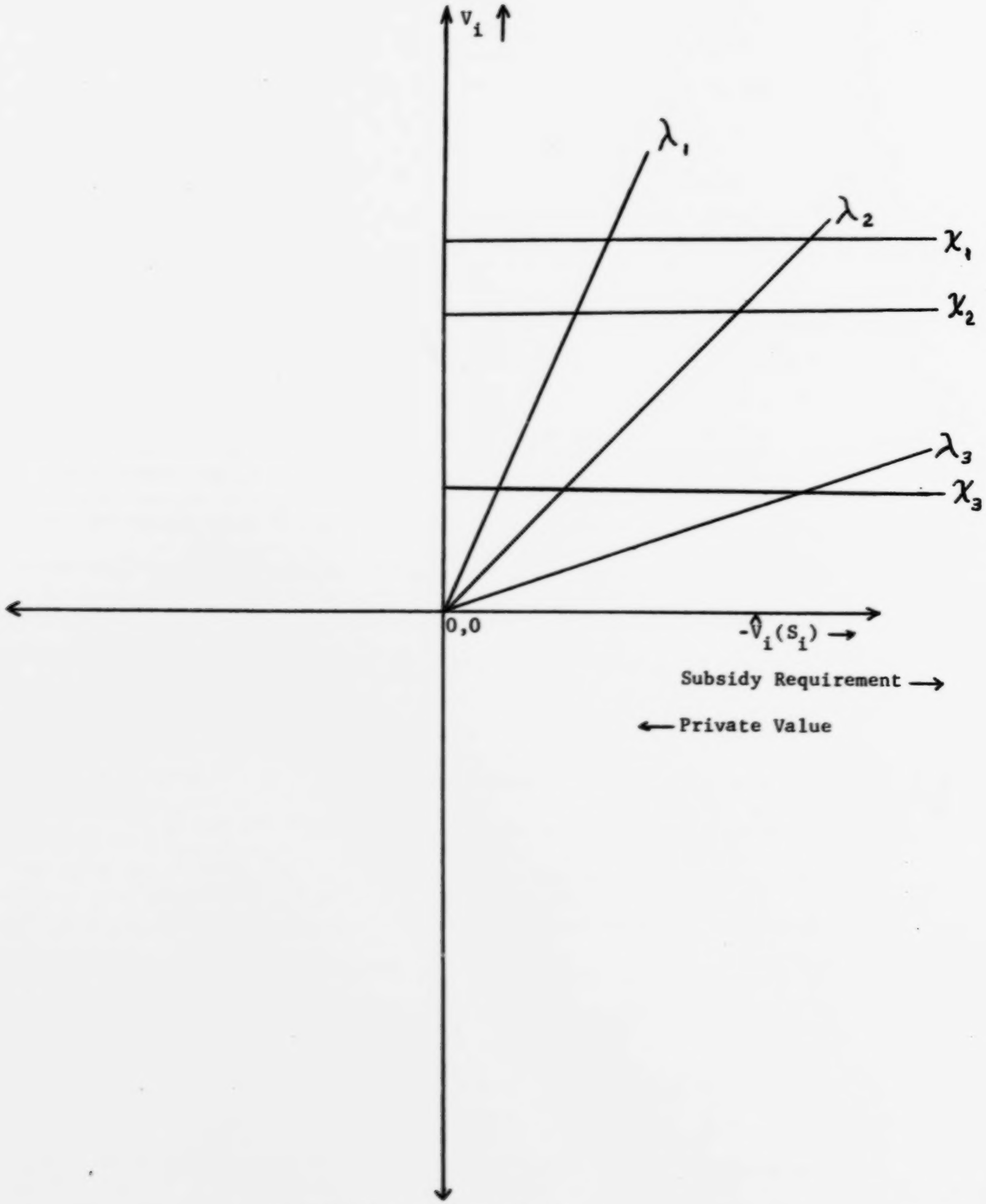
$$(9) \quad R_m = \frac{V_m}{S_m} = \frac{V_m}{-\hat{V}_m} = \lambda$$

In effect, then, rational decision-making implies that, with funds limited, subsidies will be allocated on the basis of the ratio of the social value to the deficit in the private value of each student's college education. Figure 1 presents a simple analysis of the admissions decision rule. All potential students to the left of the ordinate (i.e., for whom $\hat{V}_i > 0$) will attend college without subsidy (whether or not the social value of their education, V_i, is positive). Neither the private nor the social value of their education of those in the second quadrant is positive: they will not attend college without subsidy, they will not be subsidized, and thus they will not be expected to go to college. (See page 23.)

The proportion of those in the first quadrant who will attend college will depend upon the subsidy budget. At any given subsidy level, only those above and to the left of a ray from the origin λ, will attend (i.e., those for whom $\frac{V_i}{-\hat{V}_i}$ is greater than the cutoff value λ_1 will attend at that level of subsidy). As the budget is increased, this admissions margin is rotated in a clockwise direction from the origin until, when funds are adequate, all students in the first quadrant are admitted.[36] The tangents of the angles formed by each of these rays and the abscissa are equal, of course, to the marginal social value to be obtained from an expenditure of a dollar of subsidy at that subsidy level.

For comparison, a decision rule of the Moor type (with social value substituted for Moor's intellectual ability) is shown in Figure 1 by hori-

Figure 1



The Admissions Decision in a
Consistent College Subsidy Policy

zontal lines (χ's). This rule would give priority to students with the highest social value, regardless of their subsidy costs. At a given limited level of subsidy, the Moor rule would tend to exclude more students from the program and, despite the higher average social value of the college education of those who are accepted, would yield a smaller total increase in the social contribution of college education. The two rules become identical, of course, when subsidy is adequate and the budget restraint is no longer relevant.

The principal argument for subsidies to college education is that it may create positive externalities, an excess of the social over the private value of college ($V_i - \hat{V}_i$), at least for some groups of students. It was argued above that a rational scholarships policy would allocate subsidy dollars where these positive externalities were greatest. It can easily be shown that the subsidy policy suggested here does just that.

The rule used to determine whether a marginal student should be admitted for subsidy and the marginal rule for increasing resources per student will each give identical results if unity is added to both sides of the equation:

$$(10)\quad \frac{V_m}{-\hat{V}_m} + 1 = \lambda + 1;$$

$$(11)\quad \frac{-dV_m}{d\hat{V}_m} + 1 = \lambda + 1$$

By utilizing the equation (6), $S_i = -\hat{V}_i$, and rearranging terms, (10) and (11) can be rewritten:

$$(12)\quad \frac{V_m - \hat{V}_m}{S_m} = \lambda + 1;$$

$$(13)\quad \frac{d(V_m - \hat{V}_m)}{dS_m} = \lambda + 1.$$

Hence, if the subsidizing agency is maximizing its objective function, the externality of an expenditure would be compared with its cost in each case, and funds would be allocated where the externality per dollar was greatest. Thus, only those potential students for whom the ratio of externality to subsidy cost is greater than $\lambda + 1$ would be accepted. Similarly, subsidies would be allocated to improve quality education up to the point where the externality generaged by an additional dollar of subsidy is equal to $\lambda + 1$.

It was also argued above that a useful decision rule for college student subsidy should consider simultaneously the several types of externalities generated by the subsidized education of a student. It can very easily be shown that the policy suggested here satisfies that condition as well. Simplified models of agency and student decision-making[37] are introduced such that the social value of the ith individual's education is:

$$(14)\quad V_i = \frac{Y_i - X_i}{r} - 4(X_i + K_i),$$

where Y_i is the marginal social benefit per year of the ith individual if he graduates from college, X_i is his annual marginal social benefit if he does not, K_i is the expenditure of educational resources on him during each of his four years of college, and r is the social rate of time preference and the private value of college to the ith individual is:

$$(15)\quad \hat{V}_i = \frac{Y_i - X_i + Z_i}{\hat{r}_i} - 4(X_i + K_i - W_i),$$

where r_i is the ith student's rate of time preference, Z_i is the difference between the private and the social annual benefits he receives as a result of his college education, and W_i is the difference between the annual private and social costs of his going to college.

Then,

$$(16)\quad \frac{V_i - \hat{V}_i}{-\hat{V}_i} = \frac{(Y_i - X_i)\left(\frac{1}{r} - \frac{1}{\hat{r}_i}\right) - \frac{Z_i}{\hat{r}_i} - 4W_i}{S_i}$$

$$(17)\quad \frac{\frac{d(V_i - \hat{V}_i)}{dK_i}}{\frac{-d\hat{V}_i}{dK_i}} = \frac{Y_{ik}\left(\frac{1}{r} - \frac{1}{\hat{r}_i}\right) + 4W_{ik} - \frac{Z_{ik}}{\hat{r}_i}}{\frac{dS_i}{dK_i}}$$

Equations (16) and (17) will be equal to λ for the subsidy givem to the marginal student accepted into the program and the marginal subsidy dollar given to each subsidized student, respectively. Thus, students for whom the algebraic sum of the three types of externalities [those arising from an excess of social over private benefits ($\frac{Z_i}{\hat{r}_i}$), those arising from an excess of private over social costs ($-4w_i$), and those arising from an excess of the private over the social rate of time preference $(Y_i - X_i)\left(\frac{1}{r} - \frac{1}{\hat{r}_i}\right)$]^{38} is largest per dollar of subsidy will receive aid. Moreover, the value of the sum of the additional externalities arising from these three sources per additional dollar of subsidy will determine the level of resources allocated per subsidized student.

The Effects of a Consistent Subsidy Plan on the Allocation of Resources in College Education

The effect of substituting a more rational subsidy plan for the existing hodgepodge will very much depend upon the funding of the new plan. A suboptimal level of subsidy, no matter how effectively administered, cannot produce an optimal allocation of resources; in fact, if total subsidy funds were set at a very low level, it is reasonably certain that the resulting allocation of resources would be inferior to that of today, no matter how efficiently the funds were administered. To allocate a very small subsidy fund rationally, education of a few students granted aid would have to have a very high external economy and/or a very low subsidy cost. In such circumstances, a small fund could be used to good advantage. However, the overall allocation of resources would not be dominated by the subsidy plan, but rather by students' evaluation of the private benefits and the private (unsubsidized) costs of their education.

The shortcomings of the present system would then tend to be intensified. There would be a decline in the number of college graduates, as well as in resources expended per student. There might also be important changes in the geographical, religious, and occupational distribution of the student population. College resources today are allocated not only on the basis of private costs and benefits but also--as a result, essentially, of the subsidy system--on the basis of estimated social benefits and the preferences of donors and college administrators.

With a drastic reduction in subsidy, one might expect a relative decline in the proportion of college graduates from areas which now have a highly subsidized public or private system, an increase in the proportion of atheists (since they gain least, presumably, from the system of religious colleges), a decline in the number of scientists relative to advertising men, and so forth.

With a low subsidy, one would also expect an increase in the proportion of middle- and upper-class students in the college population. The tendency of the private market to generate economic inequalities in the allocation of college resources is modified somewhat by the subsidy system. Colleges estimate a student's financial need in considering him for a scholarship[39] and tuition levels are typically set below cost, which enables at least some poor or lower-class youths to finance a college education (at least at one of the less expensive colleges).[40] The elimination of such subsidies would place a disproportionate burden on the poor, and probably would exclude even more of them from college.

One important bias in the present allocation might, however, be curtailed: a drastic reduction in subsidy would almost certainly reduce the proportion of able students in the college population.[41] It is unlikely that this fraction would be lowered to the proportion of able students in the total population of high school graduates; the high private monetary rate of return to the able of college education,[42] together with the positive association between academic ability and social class,[43] would mitigate against that outcome.

However, since most college student subsidy plans today do favor the intellectually able student (both directly, through scholarship policy and indirectly, through restrictive admissions at the better, more heavily endowed colleges),[44] a reduction in subsidy would be expected to reduce the extent to which intellectual ability determines investment in college education, especially at the private colleges.

If, as is not altogether unlikely, the adoption of a more consistent scholarships policy were accompanied by an increase in subsidy to an adequate level, the allocation of educational resources could, of course, be made in a socially optimal manner. The budget constraint in this model would no longer be a limitation, and externalities could, in principle, be eliminated through appropriate subsidy. In most cases, the social value of college for an individual would determine whether he attends college and the quality of the college he chooses. The private value of college to him would determine only the financial contribution which he would be required to make. An important exception to this might be the "overinvestors" since educational resources would be available to all at cost, those for whom the private value of education exceeded the social value would be permitted to "overinvest" in their college education.

If the funds available were equal to what could be obtained simply by pooling all present student subsidies (including such indirect subsidies as setting tuition rates below cost), the resulting allocation of educational resources would be intermediate between the two extremes, drastic reduction in subsidy and totally adequate subsidy.

Many students, probably a majority, could be assisted, and thus it would not be accurate to say that the private value of college would determine the allocation of resources. However, unless the estimate of the social value of education were set rather low, at such a level of funding many students for whom it is positive could not be supported (the assumption is that those for whom the social value of college is not very much greater than zero or those for whom the private value of college is much lower than zero would be rejected). Nor could expenditure per student be raised to that optimal level at which the social benefits of further expenditure were no greater than the additional social cost.

The allocation of funds aming students would also differ from the extreme cases. A student whose education was rated as having a high social value would be in a good position to obtain subsidy. However, a high private value (whether or not it is associated with a high social value) would also be helpful to him here, since it would reduce the cost of subsidizing him, thus making him more attractive as a candidate. The weighting of public and private values in deciding this intermediate case can be expressed more precisely by rewriting equation (9), for the marginal student admitted into the program as:

$$(18) \quad V_m + \lambda \hat{V}_m = 0$$

and equation (18) for the marginal dollars spent of improving educational quality as:

$$(19) \quad dV_i + \lambda \, d\hat{V}_i = 0$$

Thus, the relative weight of social and private values would be a simple function of λ, and hence of the size of total subsidy.

This weighting of values in the allocation of college resources takes place to some extent in the rather less systematic allocation we have today. However, even if the amount of funds available was not increased, coordination of existing subsidies could lead to important changes in the allocation of resources among students. For example, it was argued above that the present emphasis on intellectual ability as a criterion for student aid would most likely be downgraded and supplanted by a consideration of broader social values. However, this shift is not inevitable. If the national interest called for the training of an intellectual elite, a coordinated subsidy policy would make it possible to pursue this goal with greater vigor and efficiency. A decentralized, college-oriented subsidy system now encourages some of the lower-quality colleges to offer scholarships to whatever students they can attract, including some who are not among the most able in the country. While this may be unlikely in the United States at the present time, a coordinated student-oriented system could permit policymakers to increase the emphasis on academic ability in the allocation of college resources.

An explicit consideration of the quality-quantity decision (number of students to be trained versus amount of resources per student) in the context of a national scholarships policy might lead, somewhat more plausibly, to unexpected results. In the United States an emphasis on social rather than academic gains from education has been traditionally associated with mass education. However, if policymakers in fact believed that there were some important increasing social

returns to raising the resource-student ratio, a national scholarships policy could lead to a reduction, rather than to an increase in the college student population.

This quantity-quality decision will also help determine the importance of the private value of college to the individual (and thus of his financial resources and of his preference for further education) in deciding his college career. If the nation chooses high-quality education for the few as its goal, then (unless there is some offsetting bias in favor of lower-class students, so that a very few poor students receive high-quality education) the best use of a limited subsidy to achieve that end is to select those students for whom the private value of college is high, and who are thus both able and willing to pay more for their college education.

This bias against the poor in allocating subsidy has an analogy in the present allocation of resources: today, although competition among the best colleges keeps tuition well below the level of teaching costs, it remains too high for the average high-school graduate. In consequence, in the present distribution of subsidy some of the largest amounts go to the wealthier students.[45] Moreover, we have seen that in both the decentralized and the coordinated subsidy systems the really poor student may be denied all financial help, even though he is above average in ability. Thus it would appear that, despite the optimism of some reformers, the rational coordination of student subsidies into a national policy might well replicate a number of anomalies of the present system. While one may predict that

social values would be likely to take precedence over academic goals and that, whatever the goals, they could be pursued with greater efficiency, coordination of a limited subsidy budget need not lend to a more nearly egalitarian allocation of college teaching resources.

However, it is likely that a national scholarships policy would serve as a powerful impetus to increase the present subsidy level and hence to extend quality college education to a larger group of the population. A rationalized system would clearly establish a system-wide λ and thus a cut-off benefit-cost ratio for those without funds.[46] If this cut-off benefit-cost ratio is significantly greater than unity at the present level of subsidy (as may well be the case), then there might be a concerted effort to increase expenditure on college teaching to the level where λ is reduced to zero and the benefit-cost ratio is at unity--i.e., to the point at which all students for whom the marginal social benefits of education exceed the costs will attend a college of at least optimal quality. The attempt made here to reduce or eliminate the undesired redistributive and allocative effects of the increase in subsidy would facilitate and perhaps make such a step more acceptable politically.

Conclusions

1. A coordinated, consistent scholarships policy would: (a) explicitly consider the externalities (the differences between the social and private values) generated by the education of various cohorts in the population of high school graduates; (b) assign a minimum subsidy to each student based on the quality level of the college he attends. This might be done by estimating the private value of this education to him, and then setting subsidy at a level equal to (or, in practice, marginally greater than) any deficit in this private value; (c) proceed to select students for subsidy for whom the externality per dollar of minimum subsidy (alternatively, the social value per dollar of subsidy) is highest; (d) increase resources per student in the same way, giving preference to quality improvements which produce the greatest externality per dollar of subsidy. In this way, the maximum social value could be obtained from a given subsidy budget. This method would provide a more refined instrument than such across-the-board subsidy methods as low tuition rates or low interest rates on student loans for all students, each of which has undesired redistributive and allocative effects.

Moreover, although existing college scholarships principles and practices afford useful models for the design of a national college student subsidies policy, that policy would differ from the individual college plans in that it would emphasize broad social values rather than the more narrow academic concerns of the colleges. Further, it would have to make more important decisions on the quantity-quality margin than are required of the individual colleges, and hence would have to develop explicit guidelines for such decisions.

2. The effect of a national subsidy policy would very much depend upon the total subsidy budget. If rationalization were accompanied by a sharp reduction in total subsidy, social values would have little influence, and the allocation of educational resources would be determined by the calculation of private gains and losses. But if the budget were raised to an adequate level, social values would determine resource allocation. One result would be that a student's poverty would not bar him from attending the highest-quality college.

If subsidy funds were held at present levels but administered so as to obtain maximum social benefit, a number of changes would be likely in the allocation of college resources. There would probably be a de-emphasis on academic ability as a criterion for subsidy. However, certain characteristics, especially the important role of the student's financial resources in obtaining a college education, would probably remain. The higher quality institutions would continue to admit disproportionate numbers of middle-class students, and the poorest youths would be largely excluded from the college system.

3. An important contribution of a more consistent college student support program might result if the explicit consideration of the positive externalities generated by the college education of some students when subsidy is limited, which a consistent policy would demand, led to an expansion of subsidy funds to an optimal level, unlike the other reform measures considered, this approach would minimize undesired redistributive and allocative effects, and hence might more readily gain the necessary political support.

FOOTNOTES

[1]In order to simplify the discussion, only externalities arising from completed four-year college programs will be considered here. However, important externalities might also be generated by college dropouts, as well as by graduates of two-year colleges. Moreover, it has been argued that any calculation of benefits from college should include the value of the option of further education to those who complete part, but not all, of the four years; see Burton A. Weisbrod, "Education and Investment in Human Capital," Journal of Political Economy, Supplement (October, 1962), pp. 106-23.

[2]See B. A. Weisbrod, External Benefits of Public Education, Princeton University Research Report Series 105, Industrial Relations Section (Princeton, N.J.: Princeton University Press, 1964), for an extended discussion of the various social benefits of college education.

See Toward a Social Report, U.S. Department of Health, Education, and Welfare, 1969, especially chapter 2, for a useful summary of evidence relating education to social goals.

[3]See Gary S. Becker, Human Capital (Princeton: Princeton University Press, 1964), pp. 94-100.

[4]Data presented by D. Wolfle and J. Smith, "The Occupational Value of Education for Superior High School Graduates," Journal of Higher Education (April, 1956), pp. 201-213.

[5]This dissatisfaction is shared by a number of college administrators. See W. J. Bender ("A Critical Role for the Colleges," College Board Review, No. 39. [Fall, 1959], pp. 8-11) for a critique by the then Dean of Admissions and Financial Aid, Harvard College, of the existing patchwork quilt of private college subsidies and a plea for greater coordination of student aid programs.

[6]The positive correlation between wealth and intellectual ability and other factors contributing to a higher rate of return on college education will further bias the composition of a "free" college in favor of middle-class students; cf. the analysis of the California state college system in W. Lee Hansen and Burton A. Weisbrod, Benefits, Costs, and Finance of Public Higher Education (Chicago: Markham Publishing Company, 1969).

[7]Hansen and Weisbrod observed a tendency for better-off college students to attend higher quality units of the California state college system.

[8]Benefits and costs are expressed in certainty-equivalents, as are the benefits and costs in the model of social choice. In these models, then, differences between the attitudes of the agency and of the student toward the uncertainty of the student's future benefits would appear as a difference between social and private benefits. If repayments are permitted, differences in attitudes towards uncertainty can be used to increase the benefits from the subsidy program.

[9]S. Mushkin, editor (Washington: U.S. Department of Health, Education, and Welfare, 1961) p. 214.

[10]Moor's rule is, of course, superior to college practice in that he would eschew altogether the principle of giving across-the-board tuition subsidies to non-scholarship students.

[11]Moor's policy would be rational if each student had a separate ability rating and each policymaker had a lexicographical preference ordering with respect to student ability (so that one student with, say, an I.Q. of 140 would always be worth more to the college system than one hundred students with I.Q.'s of 139).

[12]Of course, since scholarship needs are calculated today in terms of subsistence costs, not private opportunity costs, many poor students cannot afford to attend college even if offered "full scholarships." Students whose earnings are needed at home are an obvious example. To reach these people, scholarships and other aid may have to be raised to the level of private opportunity costs.

[13]The quality of a college education will be defined throughout this paper simply by the value of resources allocated to the education of the average student in residence. This definition would gain in plausibility if the reforms suggested below were adopted--if colleges provided their services at full marginal costs and all subsidies were given directly to students who then selected their college. In that event, variations in resources spent per student would at least reflect the student's evaluation of quality. The present system of subsidy allows donors and administrators to divert some resources to what has been aptly termed "the production of monuments."

[14]S. E. Harris, Higher Education: Resources and Finances (New York: McGraw-Hill, 1962), p. 180.

[15]See Donald P. Hoyt, "College Grades and Adult Accomplishment: A Review of Research," The Educational Record (Winter, 1966).

[16]John L. Holland, "Creative and Academic Performance Among Talented Adolescents," Journal of Educational Psychology, Vol. 52, No. 3 (1961). See also John L. Holland and James M. Richerden, "Academic and Nonacademic Accomplishment: Correlated or Uncorrelated?" Journal of Educational Psychology, Vol. 56, No. 4, (1965).

[17]Hansen and Weisbrod would use the term "value-added" to denote the net benefit of an individual's college education.

[18]See H. Daniere, Higher Education in the American Economy (New York: Random House, 1964), and C. Kaysen, "Some General Observations on the Pricing of Higher Education," in S. Harris, ed., Higher Education in the United States: The Economic Problems, suppl. to Review of Economics and Statistics, Vol. 42, no. 3 (August, 1960), for a discussion of the difficulties of measuring the cost to the college of educating a student.

[19]See Daniere, op. cit., especially chapters 10-11, for a discussion of these problems.

[20]In this model, the temptation to behave monopsonistically only arises when the budget acts as a constraint, so that it may be taken as one more argument in favor of an adequate subsidy.

[21]See the discussion in Appendix II "The Problem of Interdependence."

[22]The agency might decide to train such students but to use large classes, teaching machines, and lower quality teachers, or it might make other substitutions for able teachers. In any event, these monopsony considerations are likely to be less important in the long run, since one would expect the supply elasticities of teachers and other resources to be higher in the long run.

[23]Overcharging of wealthy students would, of course, be a way of obtaining at least part of the subsidy funds needed for a national scholarship program. See Hansen and Weisbrod, op. cit., p. 101.

[24]The agency would have to ascertain whether a college was actually charging a living expense as part of its tuition.

[25]cf. the discussion in Hansen and Weisbrod op. cit. especially pp. 98-102. The authors suggest that a college scholarships program could be accompanied by other programs, such as job training and investment in small business, designed to assist non-college youth, thus alleviating the distributive inequities of the college scholarship program.

[26]This holds only if non-pecuniary income is included as well. If the non-pecuniary benefits of college are positive, then a recipient should be given a subsidy such that the private value of the pecuniary benefits and costs (discounted at an individual rate of return) is negative.

[27]See the discussions in M. V. Pauly, "Mixed Public and Private Financing of Education," American Economic Review, 57 (March, 1967), pp. 120-130; Walter Hettich, "Mixed Public and Private Financing of Education: Comment," American Economic Review, 59 (March, 1969), pp. 210-12; and Mark V. Pauly, "Mixed Public and Private Financing of Education: Reply," American Economic Review, 59 (March, 1969), pp. 212-13.

[28]In the short run, though, the maximum investment is fostered by the scholarship program, not the loan program. If the student's financial contribution to his education is positively related to his estimate of the present value of his college education, and if the present value of his college education is reduced by the condition that he must make payments to the agency out of his income (and its value further decreases with an increase in these repayments), then his contribution will be reduced when some repayment is required. Hence, a given amount of subsidy dollars will spur a greater investment in college in the years in which it is spent if it is given without repayment conditions than if it is given as a loan.

[29]In practice, some decentralization in preference-making might be incorporated so that more than one view of a student's merit could be expressed.

The agency must also be able to measure its social time preference. This level of time preference, r, can be crucially important in ranking students. If two students receive equal rank (R), and one has a high social internal rate of return to his potential education but is unable to pay for a large proportion of it, while the other is wealthier but has a low social internal rate of return, an increase in the social rate of time preference, r, will lead the poor student to be favored; a decrease in r will lead to the wealthy student being favored. Let student i have an internal social rate of return of 10 percent and be willing to pay two-thirds of his education, and let the rate of return be 15 percent for j, who will only pay one-third of his education. At r = 5 percent, the two students will be ranked as equals by the agency. At $r < 5$ percent, the agency will favor the poor student, j; at $r > 5$ percent, the wealthy student, i will be favored. See below, pp. 19-26.

[30]See S. Marglin, "Objectives of Water Resource Development: A General Statement" and "Economic Factors Affecting System Design," in A. Maass et al., eds., Design of Water Resource Systems: New Techniques for Relating Economic Objectives, Engineering Analysis and Governmental Planning (London: MacMillan, 1962), for a solution in a rather similar case. However, a computational solution here will be somewhat more difficult than the case Marglin discusses, because he assumes strictly diminishing returns to investment. We have no reason to rule out the possibility that $Y_{kk} > 0$ for certain ranges of K for many individuals, and thus a solution here must concern itself with the problems of minimal solutions and of local optima.

[31] V_i and S_i are assumed here to be continuous functions over individuals. For a given individual, V_i and S_i will be assumed to be continuous functions of K_i. In a national sample of millions of students, it is unlikely that departures from these continuity assumptions would be important.

[32] See G. Becker, Human Capital, National Bureau of Economic Research General Series, no. 80 (New York: By the Bureau, 1964), for an informative treatment of the individual's college decision in terms of investment theory.

[33] The costs of college here include tuition and the value of foregone earnings. In practice, the tuition measure might be expanded to include books, fees, the expense of maintaining two households, and other direct costs of sending a son or daughter to college. On the other hand, opportunity costs would be reduced by student earnings from part-time employment.

[34] Actually, S_i must equal $-\hat{V}_i$ plus some small, positive amount in order to ensure that the high school graduate will have some preference for going to college. A special problem arises in the case of the "underinvestors," those who would to to a lower quality school if they were not subsidized. In this model the underinvestors continue to have the option of attending the lower quality school of their choice and paying the full cost. Since this option presumably has some positive value to them, the subsidizing agency must pay them more to attend the college it prefers than would be necessary if the choice were between this college and none at all. If the private value of investment in the college chosen without subsidy is $\hat{V}_i'$, then the minimum subsidy to be paid to students in this group is equal to the private value of the loss they incur by going to the higher quality school, $\hat{V}_i' - \hat{V}_i^*$. If this constraint were relaxed, i.e., if the agency could simply tell the student the amount of tuition he would have to pay to go to college, the requisite subsidy for the underinvestor could be made equal to $-\hat{V}_i^*$ where $\hat{V}_i^* < 0$, and equal to or less than zero where $\hat{V}_i^* \geq 0$. Thus the free choice offered the student by this constraint raises the student subsidy by $\hat{V}_i'$ where $\hat{V}_i < 0$, and by at least $\hat{V}_i' - \hat{V}_i^*$ where $\hat{V}_i^* \geq 0$.

[35] Since strictly diminishing returns to K are not assumed here, multiple optima are possible. It will be necessary, then, to make certain that total as well as marginal conditions are met, e.g., to rule out such cases as

$$\frac{Y_j^* - Y_j'}{r(K_j^* - K'_j)} - 4 < \lambda \text{ even when } \frac{Y_{jK}^*}{r} - 4 > \lambda,$$

where Y* is the level of Y set by the agency, Y' is the level of Y chosen by the student in the absence of subsidy, K* is the level of K set by the agency, K' is the level of K chosen in the absence of subsidy, and λ is the value of the marginal subsidy dollar.

[36]Of course, as subsidy is increased and λ reduced, a number of changes would take place in the distribution of students over this graph. Thus, with a lower cut-off λ, investment per student would tend to increase, and hence the ratio of $\frac{V_i}{-\hat{V}_i}$ would tend to decline for individual students. Moreover, with more college graduates in the population, both the social and the private value of college might be lowered for many students, thus yielding further reductions in the $\frac{V_i}{S_i}$ ratios.

[37]This simplification ignores annual variations in benefits, the cessation of benefits at retirement or death, and interest on or discounting of benefits and costs in the four-year period after high school graduation. However, the model will serve to illustrate the features of social choice that are most relevant to the present discussion. Benefits and costs are expressed in certainty-equivalents, as are the benefits and costs in the model of social choice. In these models, then, differences between the attitudes of the agency and the student toward the uncertainty of his future benefits would appear as a difference between social and private benefits. If repayments are permitted, differences in attitudes towards uncertainty can be used to increase the benefits from the subsidy program.

[38]This last term might be reduced to unimportant levels by an appropriate repayment scheme.

[39]As we have seen, the poorer applicant is rejected for aid altogether unless he has superior academic ability. However, if he is accepted for aid, he will receive a larger subsidy than his less needy classmates at the college he attends. (His subsidy may be less, though, than that received--in the form of tuition reduction plus scholarship--by an equally able but less needy youth who is accepted into a more expensive college.)

[40]This is important in reducing the determination of the allocation of college teaching resources by wealth or class if (a) the tuition reduction is greater at the low-cost than at the high-cost college, or (b) the price elasticity of demand for college education is inversely related to income.

[41]See J. W. Trent, "A New Look at Recruitment Policies," College Board Review, no. 58 (Winter, 1965-66): 7-11, and R. J. Havighurst, American Higher Education in the 1960's (Columbus, Ohio: Ohio State University Press, 1960), pp. 32-33, for the tendency of the more able to go to college. A. L. Sorkin, "Some Factors Associated with Tuition in Public and Private Colleges and Universities," mimeographed (Washington, D.C.: Brookings Institution, 1968), found that the able student tended to choose a college that charged higher tuition (both within the private and the publicly controlled groups). He also found that college tuition was positively associated with a vector of college-quality variables.

[42] S. Hunt, "Income Determinants of College Graduates and the Return to Educational Investment" (Ph.D. diss., Yale University, 1963), found that the private rate of return on increments to resources per student, as measured by tuition, has a strong positive relationship to student ability. Data presented by D. Wolfle and J. Smith, on earnings of high school and college graduates at different ability levels strongly suggest a positive relationship between ability and the private rate of return on college education.

[43] See P. H. Rossi and Z. D. Blum, "Social Stratification and Poverty," (Paper presented at the Annual Meeting of the Sociological Research Association, San Francisco, August 12, 1967, pp. 66-71, for a summary of the evidence of a positive correlation in the population between intellectual ability and economic class.

[44] S. E. Harris, Higher Education: Resources and Finances (New York: McGraw-Hill, 1962), pp. 229-232.

[45] See W. J. Bender, "A Blunt Warning," College Board Review, No. 45 (Fall, 1961): 24-28. See also Hansen and Weisbrod, op. cit., for an analysis of this phenomenon within the California state college system.

[46] The cutoff benefit-cost ratio for those without funds in this model equals $1 + \lambda (1 + F)$.

APPENDIX I

Problems of Preference Measurement

The effectiveness with which the subsidizing agency can use the cost-benefit techniques discussed in the text will be limited by the predicion with which it can predict student preferences: the private value which students will assign to a college of a given quality. Thus, the ability to estimate student preference accurately is required, to the extent of predicting the amount of subsidy necessary to induce a given high school graduate to go to a college of a given quality. Accurate estimates of the subsidy required to induce the "underinvestor" to move from the low-quality college of his choice to a high-quality school of the agency's choice are also required. These preferences would not be easy to discover: the individual student will have considerable incentive to conceal them, nor will bargaining be likely to lead him to express them openly.[1]

A more productive approach to the problem of determining the student's preferences would be a further extension and refinement of the means and ability tests now used by colleges for scholarship applicants. These tests could identify subgroups of high school graduates homogeneous not only in the present social value of their college education (V_i) but also in the amount of subsidy required to induce them to go to college and hence (since $S_i = -\hat{V}_i$), in the net private value of this education. If the total population of high

school graduates were broken down by financial resources, intellectui ability, opportunity costs, and the like, into many smaller groups, trial-and-error methods could be used to ascertain the value that a typical student of a given group would place on a college education.

But however clever the agency may be be in ascertaining student preferences, its price discrimination will be imperfect, and the choce of students will be, at best, only approximate. This approximation might be improved by utilizing constraint number 6 above, which permts students to make contributions other than those predicted by the agecy. Equations (14) through (17) suggest a method by which the agency can use this flexibility to further its policy aims. These aims can onl be furthered if it offers scholarships to students whom it judges to be unwilling or unable to make the requisite financial contribution, but who will in fact be motivated to do so when offered the scholarsip. Thus, if the individual is willing to make a contribution equal to te present value of his college education,

$$(20) \quad C_i = \frac{Y_i - X_i + Z_i}{\hat{r}_i}$$

then these equations imply that:

$$(21) \quad C_i \geq 4(X_i + K_i) - \frac{V_i}{\lambda}$$

so that R_i will always be greater than or equal to λ . Similarly, this constraint provides that any student in the program who wishes o vary his contribution in order to vary the quality of his education might do so along the schedule:

$$(22)\quad \frac{dC_i}{dK_i} \geq 1 - \frac{1}{\lambda}\left(\frac{Y_{iK}}{r} - 4\right),$$

so that the increment in present social value per additional dollar of subsidy $\left(\frac{dV_i}{dS_i}\right)$ will always be greater than or equal to λ. The agency would lose nothing by making such offers, and it might retain in the program students who otherwise would not go to college or would underinvest in their education.

But the use of constraint 6 may still produce suboptimal results if, within many (or all) of the groups accepted into the subsidy program, there are some students who would attend college even if they were awarded a lower subsidy than they actually received and other students who will not attend college at the subsidy level set by the agency but who would accept a somewhat higher subsidy. The loss of the latter group to the college system would be serious if it consisted of students for whom $\frac{V_i}{S_i}$ was much greater than λ (i.e., students for whom the present social value of education per dollar of subsidy was much higher than the cut-off ratio for the marginal student accepted into the program).

If the agency, perhaps through subsampling, could make some estimate of the responsiveness of group members to an increase in subsidy,[3] it could come closer to an optimal solution. A plausible solution could then be obtained by raising S_i to equal $\frac{V_i}{\lambda}$ for each group (unless a lower subsidy level, S_i, resulted in 100 percent attendance). If this rule is followed, then in each group the marginal student who accepts a subsidy will contribute the same social benefit per dollar of his subsidy.

But this rule is not in fact optimal, since it does not include as a marginal subsidy cost the increase in the average subsidy paid to each student in the group that occurs when the subsidy level is raised to attract an additional student. As a result of this increase, if this rule is applied, the intramarginal gain to the agency from those groups for which R_i was greater than λ under the original rules would be eliminated if the marginal student's subsidy S_i was equal to $\frac{V_i}{\lambda}$ (or reduced, if all the students in the group accept the subsidy).

But if these effects of the agency's marginal decision on the group subsidy are taken into account, then a maximizing rule that will meet this objection can be found. A maximum social gain will be obtained by setting

$$(23) \quad S_i = \frac{V_i}{\lambda(1 + E_{Si,N})} \quad (N \leq M),^4$$

where $E_{Si,N}$ is the percentage increase in subsidy per student required to produce a 1 percent increase in the number of students in the group who will accept the subsidy, and M is the total number of high school graduates in the group.[5]

The substitution of this rule for the original decision rule (based on an estimate of the "typical" student's behavior) would increase the proportion of students going to college in cases where $R_i > \lambda (1 + E_{Si,N})$ and reduce it in cases where $R_i < (1 + E_{Si,N})$.[6]

The importance of this problem for policy purposes depends upon the size of $E_{Si,N}$. If this elasticity can be reduced to a very low level by suitable stratification methods, then the simpler rule of setting $\frac{V_i}{S_i} = \lambda$ for a typical student may be employed without serious loss.

[1]See M. V. Pauly, "Mixed Public and Private Financing of Education," American Economic Review, 57 (March, 1961): 120-30, and W. C. Stubblebine, "Institutional Elements in the Financing of Education," Southern Economic Journal, 32, Supp. (July, 1965): 15-35, for an analysis of these problems in financing public education. See also J. M. Buchanan and G. Tullock, "Public and Private Interaction Under Reciprocal Externality," in J. Margolis, ed., The Public Economy of Urban Communities (Baltimore: Johns Hopkins, 1965), and O. A. Davis and O. B. Whinston, "Externalities, Welfare, and the Theory of Games," Journal of Political Economy, 70 (June, 1962): 241-62, for further discussion.

[2]Several small subgroups within a particular group could be offered subsidies of varying sizes. The group scholarship would then be set at level just adequate to induce most of its typical members to go to college. Underinvestors in the test groups might be offered a choice between going to a college of their choice and going to a college of the agency's choice with a subsidy. By setting the subsidy at different levels for each test subgroup, the agency could determine the amount that would just suffice to induce the average member of the group to choose a college of the quality demanded by the agency.

[3]Obviously, it cannot be known which members will respond to higher subsidies. If the agency had this knowledge, it would refine its price discrimination to offer different subsidy levels to different individuals within the group.

[4]This result is obtained by maximizing NV_i, subject to the constraint $\frac{d(NV_i)}{d(NS_i)} = \lambda$. This decision rule would not be optimal if, within the group, the social value of a student's education was positively correlated with its private value and negatively correlated with the subsidy required to induce him to go to college. If the agency's errors in estimating the private and social value of college for individuals within the subgroup are positively associated, as the proportion of students in the group induced to go to college approaches unity the use of some average level of the social value of the education of students within the group will tend to yield an overestimate of the social value of educating the marginal student. If the social value of the marginal student's education could be estimated, the correct decision rule would then be to set $S_i = \frac{V_N}{\lambda(1 + E_{Si,N})}$, where V_N is the social value of the college education of the student who is induced to go to college by a marginal increase in subsidy.

[5]This rule may be construed as violating the anti-monopsony constraint, in that the agency no longer estimates a student's cost only on the basis of the money paid to him. However, it does not take into account changes in supply price of resources or in the opportunity costs of students that result from an individual subsidy and still conforms in substance to the anti-monopsony rule.

[6]Other things being equal. Actually, if the cases where $R_i > \lambda (1 + E_{Si,N})$ predominated, λ itself would increase because of the subsidy budget constraint. If the elasticities were sufficiently high, λ would decrease.

APPENDIX II

The Problem of Interdependence

Marginal rules for the optimizing agency's social welfare function were developed in the body of this paper such that, when they are followed, the policymaker cannot improve it by any transfer of funds, at least in the immediate neighborhood of this optimum. However, this social decision rule for investment in college education is considerably more complicated in its application then are the rules used by individuals, since a social optimum requires that the marginal conditions be satisfied for all students simultaneously. But the marginal social value of any one student's going to college, or the marginal social value of an additional dollar expended on the education of a subsidized student, will be dependent on the subsidies given to all the other successful applicants.

In the calculation of $V_i = \frac{Y_i - X_i}{r} - 4(X_i + K_i)$, the elements of Y_i, X_i, and K_i of V_i will each be functions of the college education (or lack of it) of all other high school graduates. Thus Y_i, the social benefits of the ith student's college education, will be affected both by the total quantity of college education and, more directly, by the education received by college students of similar abilities, aptitudes, and interests.[1] X_i, the yearly social benefits produced by the ith high school graduate if he does not go to college, will similarly be related to the numbers entering the labor force without a college degree, as well as to the numbers entering it with a degree. K_i, the annual expenditure of resources for the training

of the ith student, will be a function of the supply price of these resources as well as of their quantity. These supply prices may be affected by the overall level of resources allocated to higher education or by the allocation of this expenditure among the different types of resources. However, while these interdependencies will make planning more difficult, they will not invalidate the use of the marginal rules as a criterion for an optimum. Further problems will be created by these interdependencies when the agency must maximize its objective function subject to constraints.[2]

One result of recognizing the influence of subsidy decisions on the supply prices of educational resources, as we have seen, is that such effects must be incorporated into the model used for selecting students for subsidy. In the present paper, this was done by introducing the antimonopsony constraint, which compels the subsidizing agency to ignore variations in the elasticity of supply of the several inputs.

[1]This interdependence will not be as close, however, as that observed by O. Eckstein, Water Resource Development (Cambridge, Mass.: Harvard University Press, 1958), Marglin, op. cit., and others in the cost-benefit analysis of dambuilding, in which the building of dam A may be required to make feasible the building of dam B, but will make the building of dam C unnecessary. The college educations of Mr. Jones, Mr. Smith, and Mr. Brown are not likely to have that relationship.

[2]Interdependencies will also exist among succeeding "generations" of college students. The social benefits and costs of a college education might best be estimated in the context of a long-term national plan in which this year's crop is determined along with a plan, or at least a forecast, for the next fifty years' supply of graduates. If possible, this plan for higher education should be made simultaneously with a long-term plan for national economic growth (see I. Adelman, M. Geier, and F. Golladay, "Education and Economic Development," paper presented to the Econometric Society, Washington, D.C., December, 1967, for ambitious examples of long-term educational planning of this type). However, for each set of estimates of the social benefits of college education derived from such a national plan, it will still be necessary to find a method of allocating scarce subsidy funds among needy college students.